Armed Forces College of Medicine

AFCM

Mesangium & renal tubules

Prof. Dr. Mona H. Raafat
Histology Department

INTENDED LEARNING OBJECTIVES (ILO)

By the end of this lecture the student will be able to:

1. **Describe** the microscopic structure of intraglomerular mesangial cells
2. **Describe** the microscopic structure of the convoluted tubules, loops of Henle and collecting tubules.
3. **Correlate** the microscopic structure of the convoluted tubules and collecting tubules to their function.
4. **Interpret** the histological changes in renal tubules in various diseases.

Renal Corpuscle
“Malpighian corpuscle”

It is formed of:

1- Bowman's capsule.

2- Glomerulus.

3- Mesangium.

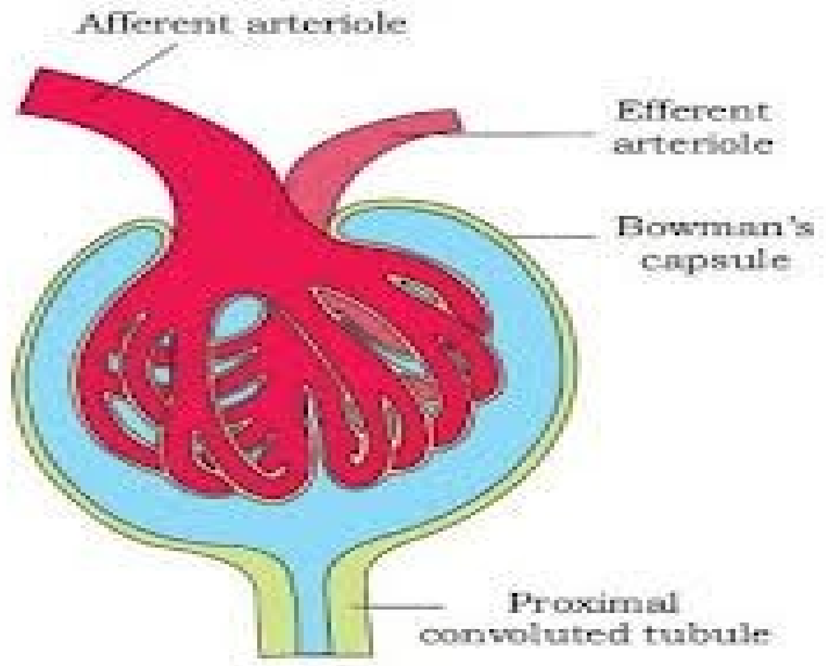


Figure 4 . Malpighian body (renal corpuscle)

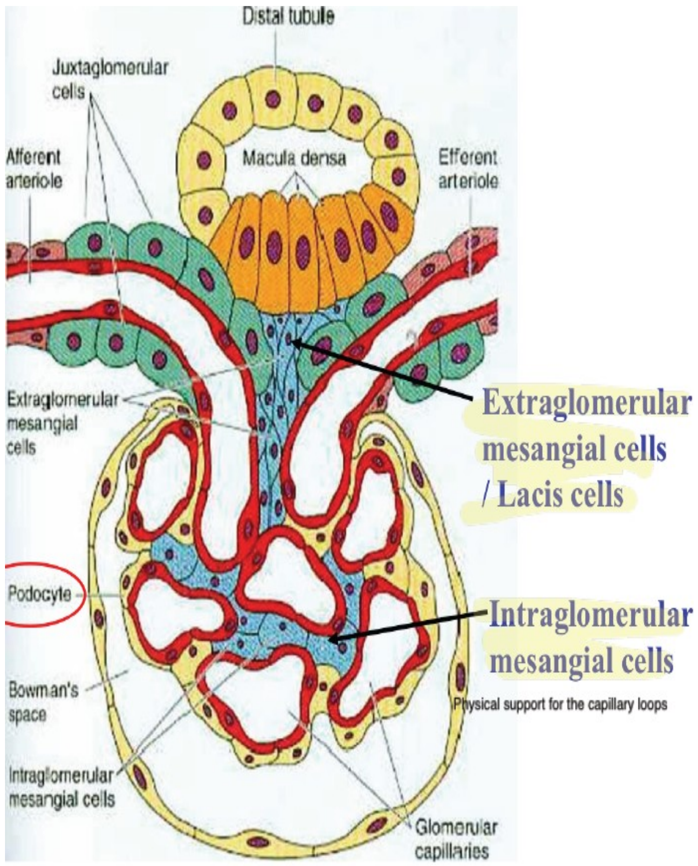
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Mesangium

- It is interstitial space between glomerular capillaries.
- Formed of mesangial cells & extracellular matrix.
- **Mesangial cells:** 2 types:

a) Extra glomerular mesangial cells:

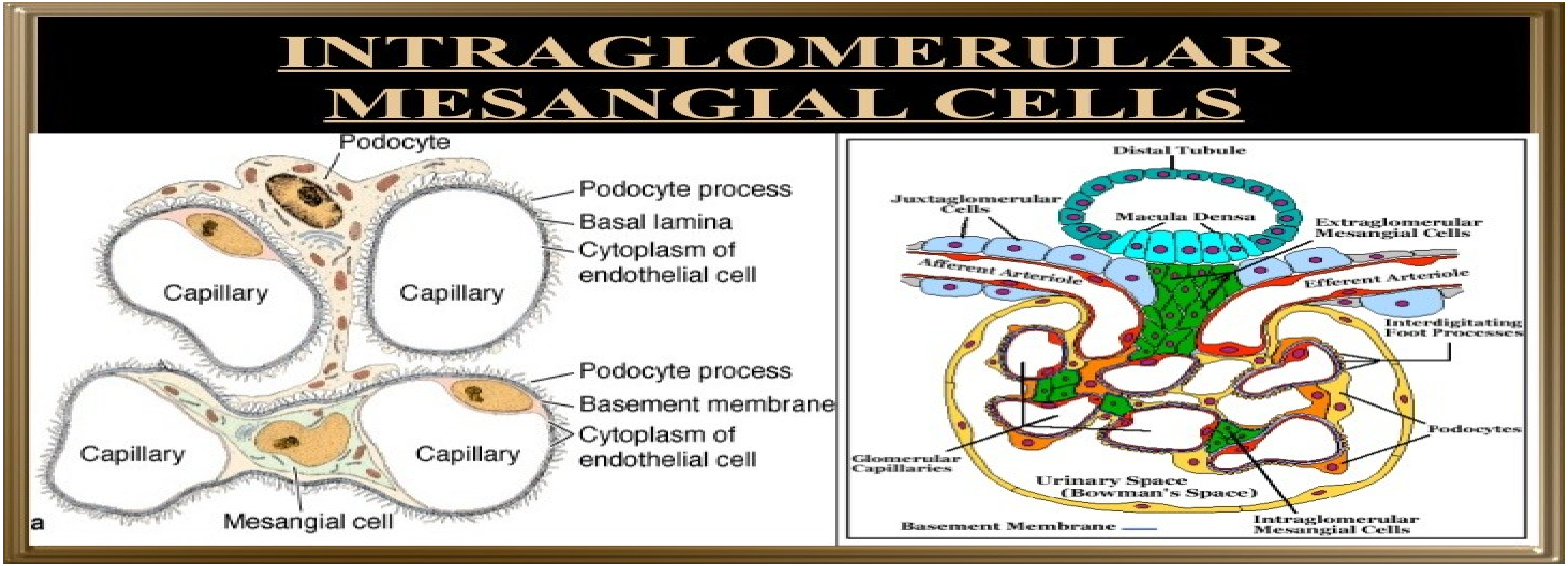
- Part of juxtaglomerular apparatus



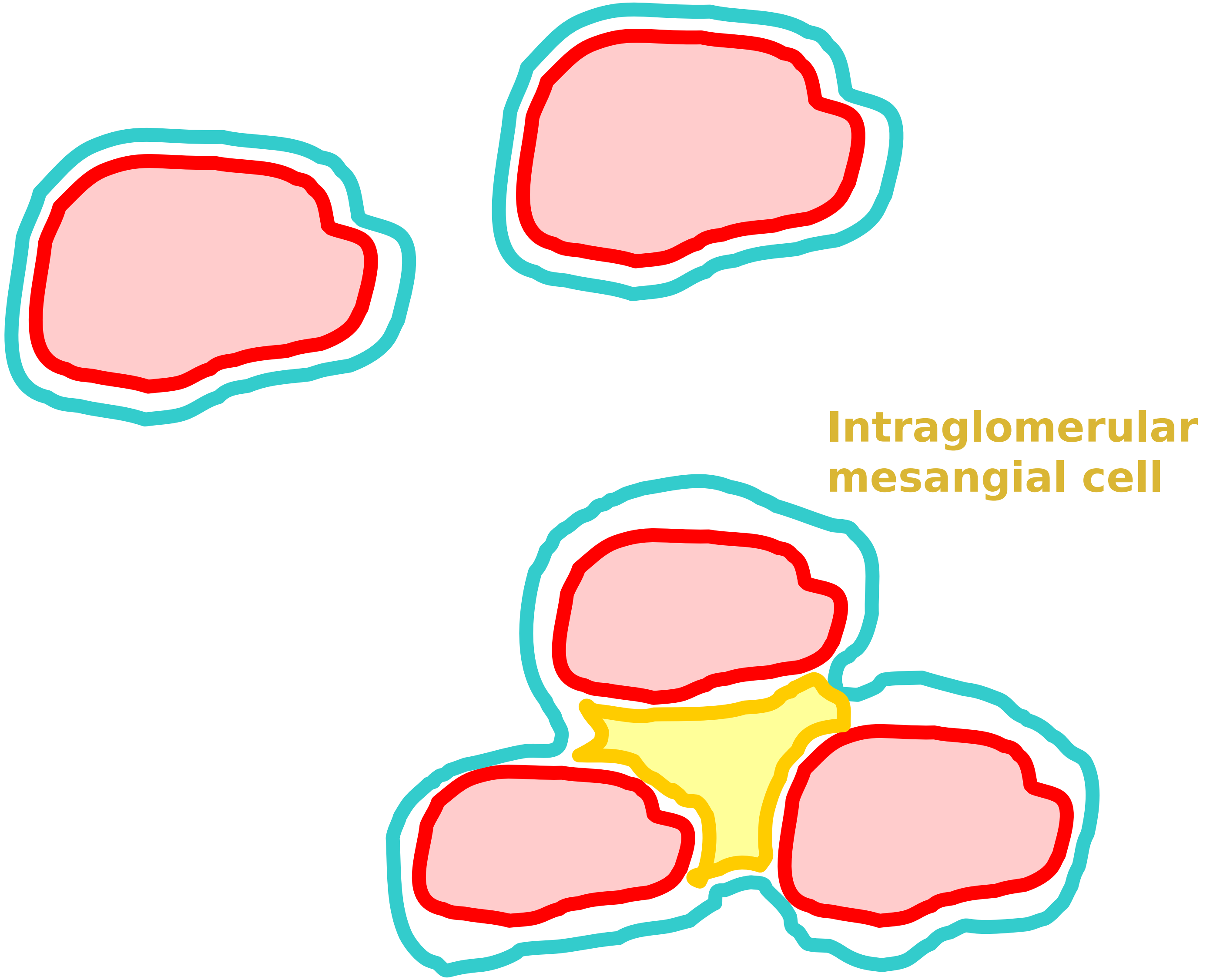
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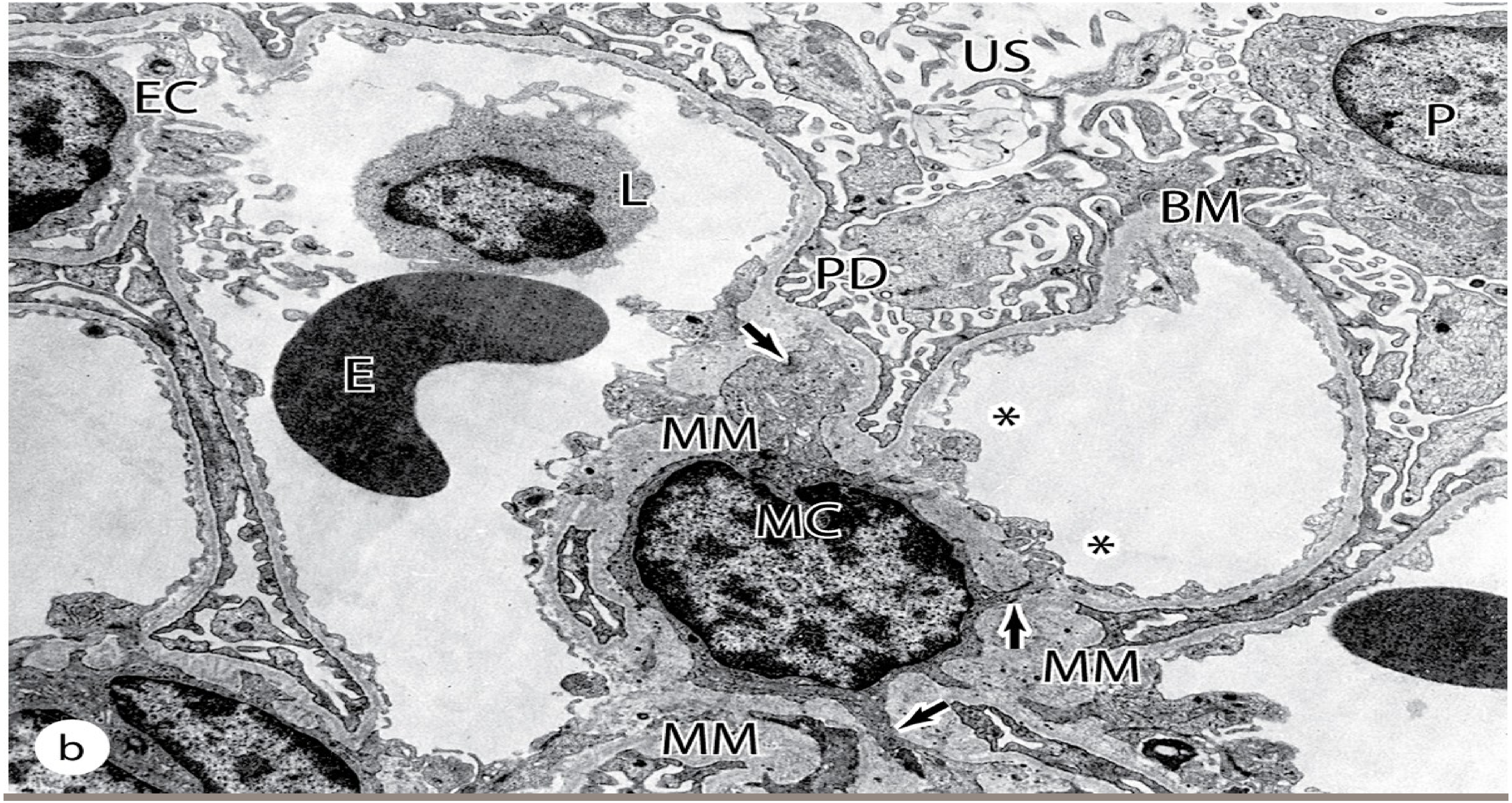
b) Intraglomerular mesangial cells:-

- Present between glomerular capillaries where the basal lamina lines two or more capillaries.



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Intraglomerular
mesangial cell



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LM:

- Stellate with many processes.
- Adherent to glomerular capillaries.
- Basophilic cytoplasm with dark nucleus.

EM:

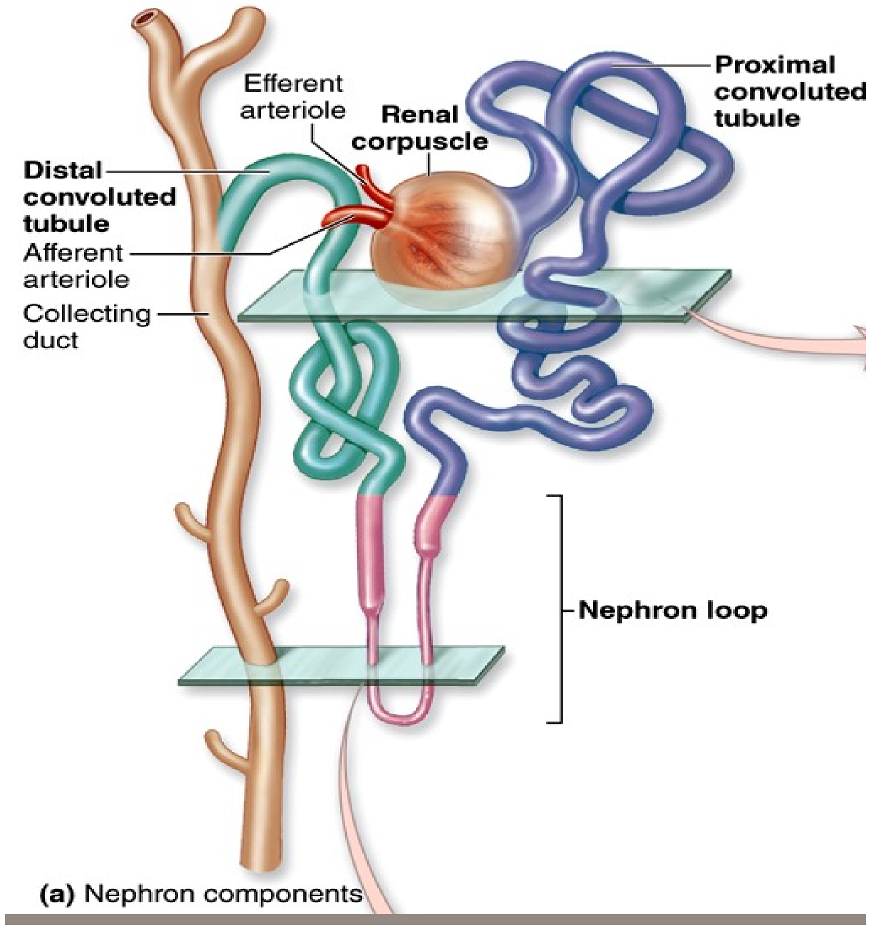
- Mitochondria , Golgi & rER.
- **Lysosomes.**
- **Lipofuscin granules.**

Function:

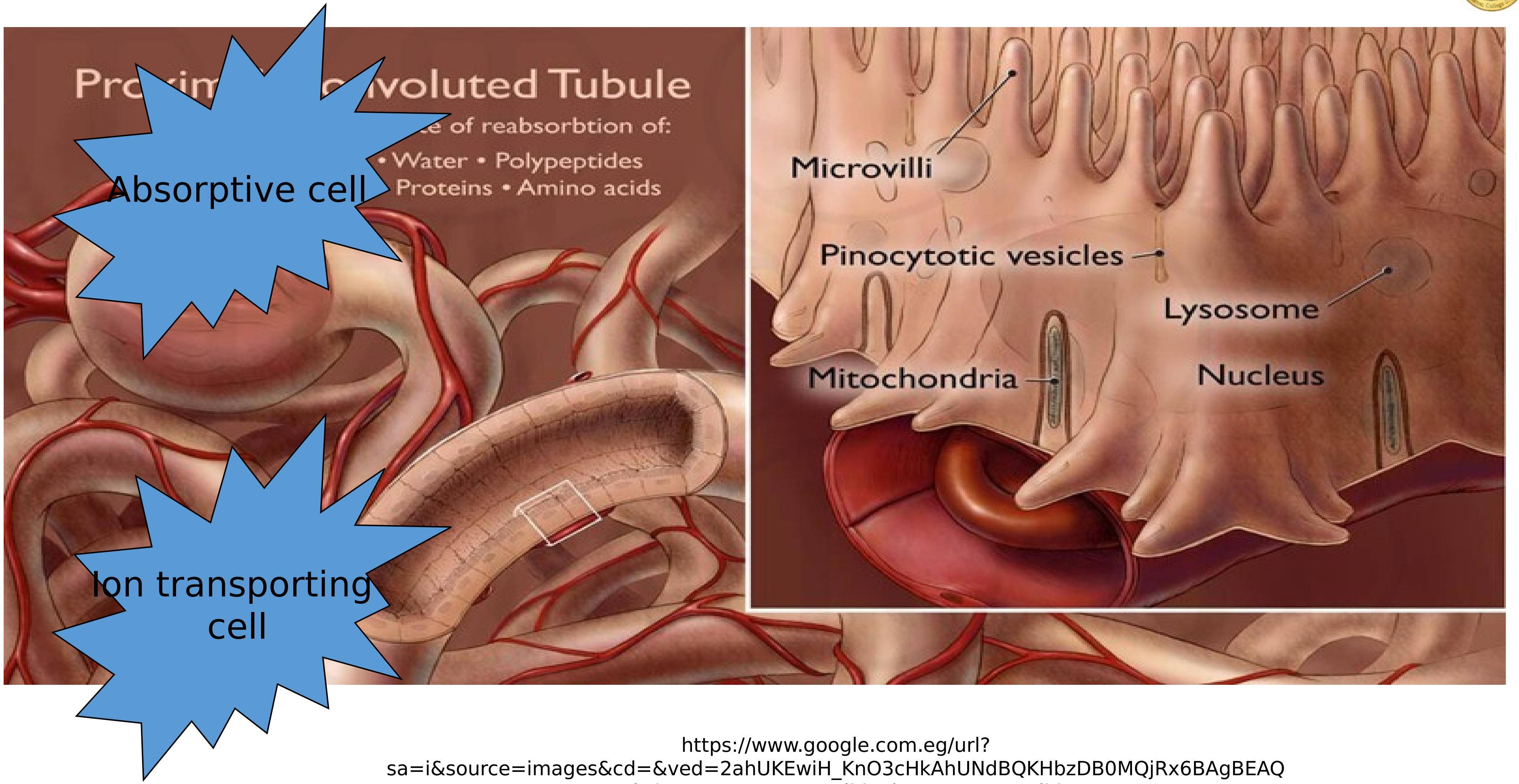
- Support for glomerulus.
- Synthesis of extracellular matrix.
- Phagocytosis of molecules trapped by glomerular basement membrane.
- Turnover of glomerular basement membrane.

Proximal Convoluted Tubules

- It begins at the urinary “tubular” pole of the glomerulus.
- It is the longest part of the nephron forming main bulk of cortex.
- It is **formed of 2 parts**: <u>straight</u> and <u>convoluted</u>



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Absorptive cell → **Microvilli**

Ion transporting cell → **Basal membrane infoldings + longitudinally placed mitochondria**

By LM:

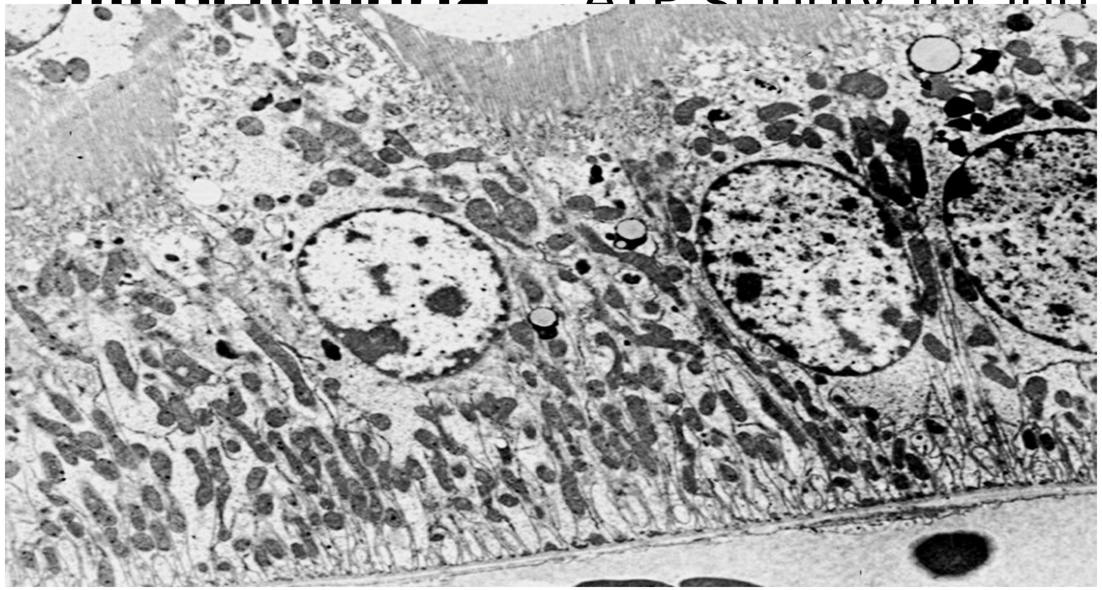
- Lining cells are large cubical epithelium.
- From 3-5 cells resting on basement membrane.
- Rounded central nucleus.
- Wide lumen “fuzz filled appearance”.
- Apical PAS +ve brush border.
- Acidophilic cytoplasm.
- Basal striation.
- Indistinct boundaries.



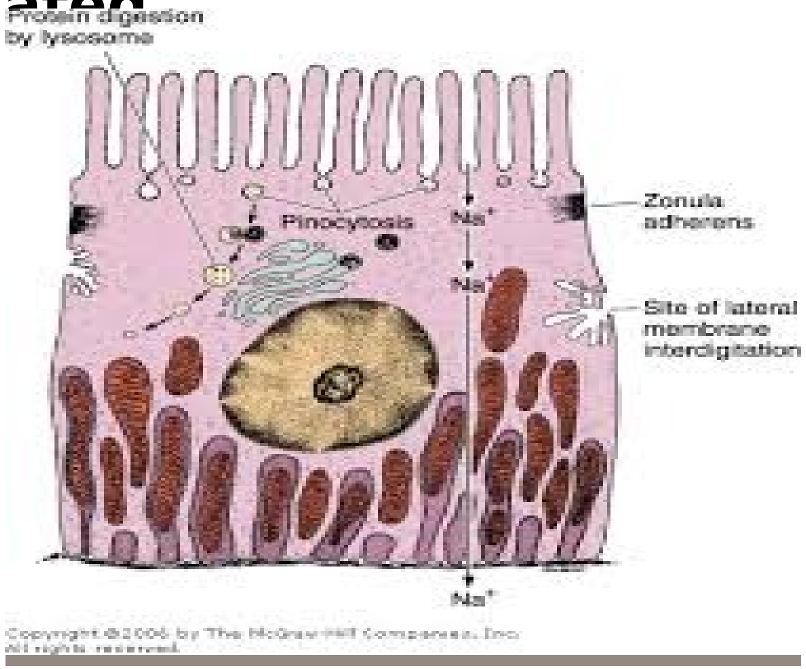
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With EM:

- **Apical microvilli** “absorption”.
- **Apical pinocytotic pits and vesicles** “pinocytosis and endocytosis”.
- **Lysosomes** “degradation of absorbed proteins”
- **Lateral interdigitation** "Na+ pump"
- **Basal membrane infoldings with basal elongated mitochondria** “ ATP supply for ion transport”



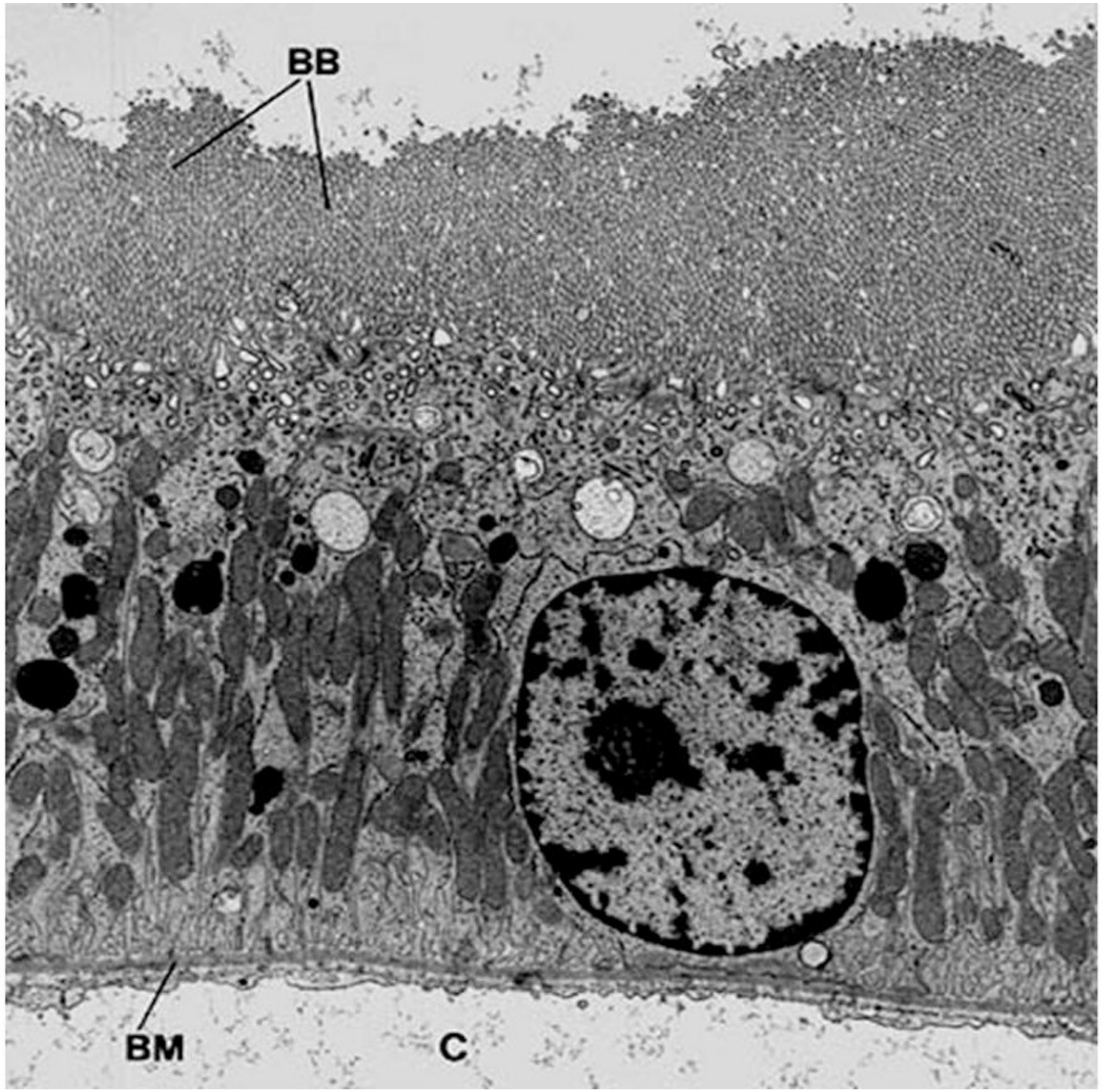
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Function

- **Reabsorption** water, sodium, chloride, glucose, amino acids and plasma proteins.
- **Secretion** of creatinine and certain drugs.
- **Hydroxylation** of vitamin D.



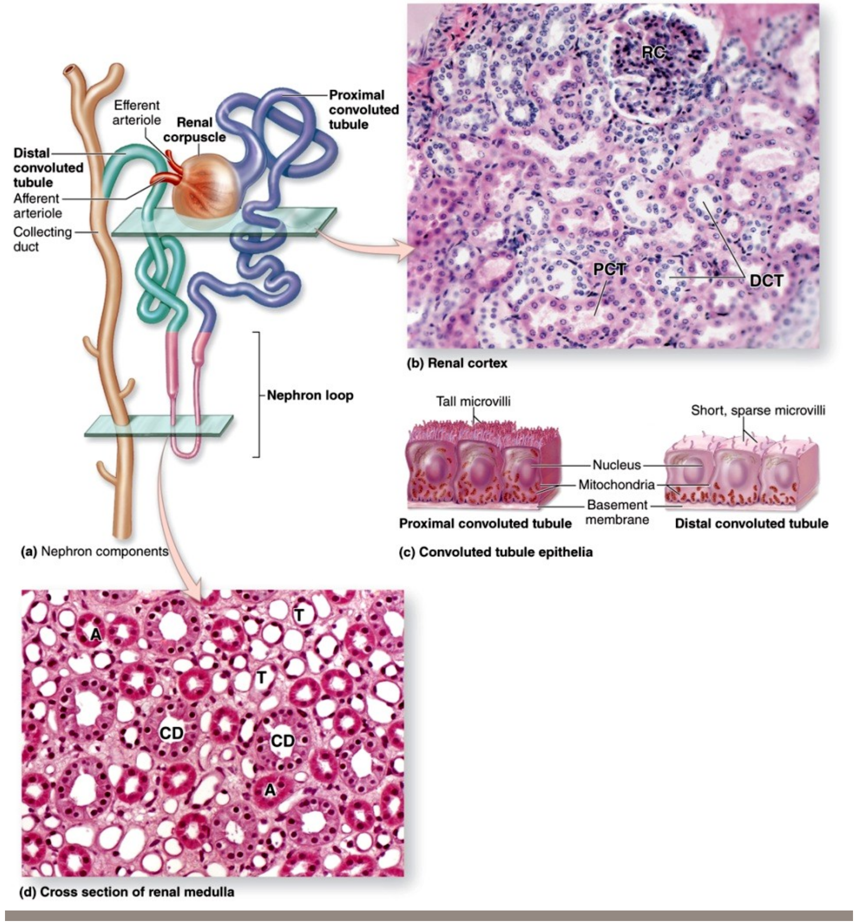
Proximal convoluted tubule cell

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Loop of Henle

- **U – shaped tubules.**

- **It consists of 2 parts:-**
  - **Descending and ascending limbs** which Lined by flat cells with flat nucleus.



Function:

- Production of hypertonic urine and maintenance of body water

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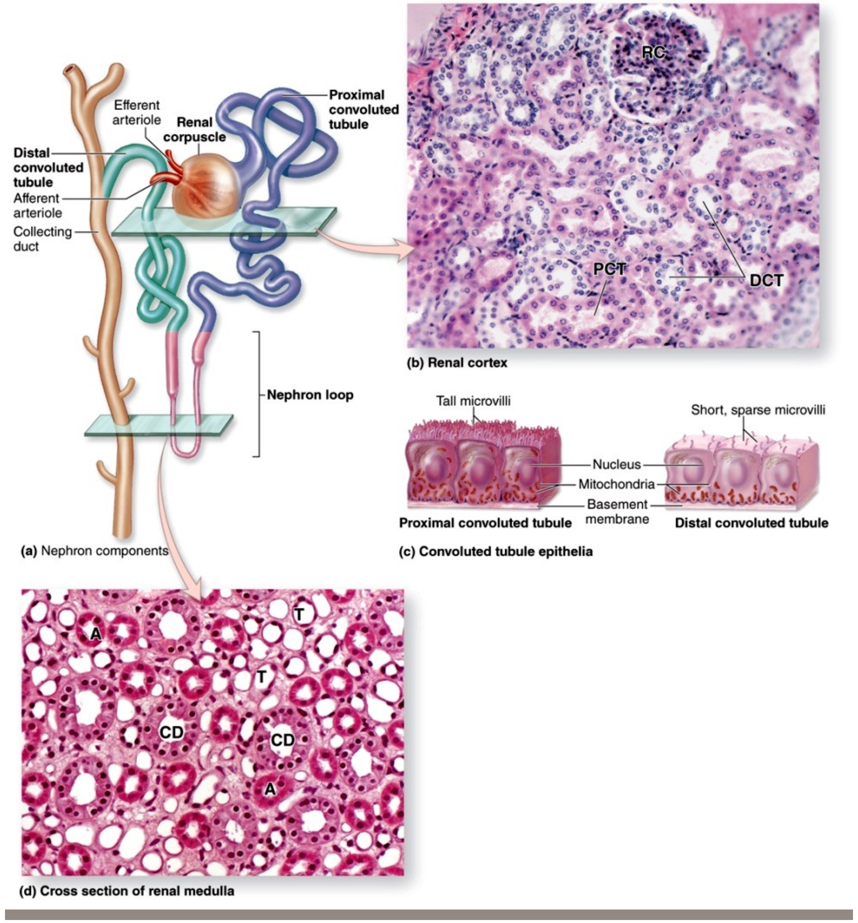
Distal Convoluted tubules

- It is **shorter** than PCT
- It is **formed of three** parts:

1- Straight part.

2- Convoluted part.

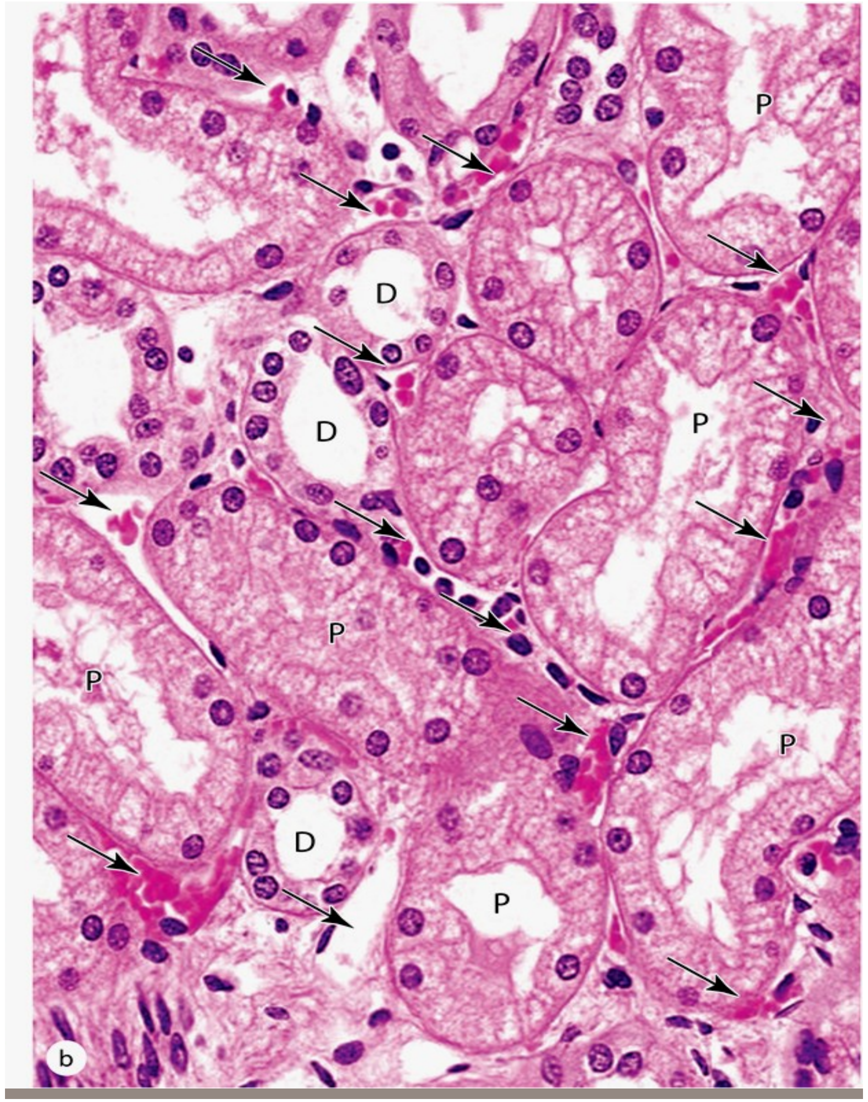
3- Macula densa (part of JGA, *see later*)



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LM:

- Cell lining is small **cubical** epithelium
- **Number of cells** are more than PCT " 5-8"
- Rounded central **nuclei**
- Cell rests on **clear basement membrane**.
- **No** brush border.
- **Lumen wider** is than PCT.
- **Faint acidophilic cytoplasm.**
- **Basal striation** "more than PCT".
- **Distinct cell boundary**.



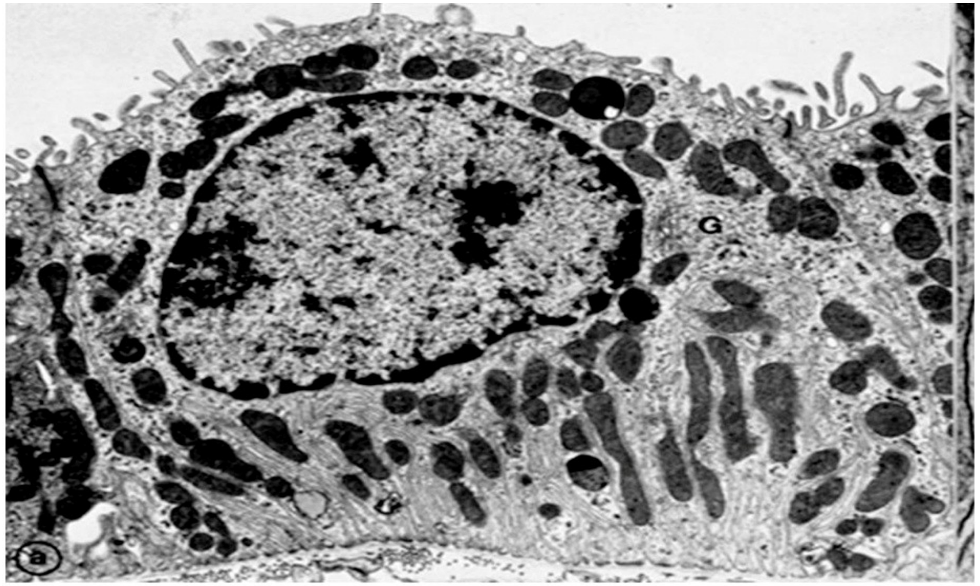
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EM:

- No apical microvilli.
- No apical vesicles.
- Less lateral interdigitation.
- Basal infolding with basal elongated mitochondria



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Distal convoluted tubule cell *"ion transporting cell"*

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Function:

- **Reabsorption** of water and regulate concentration of ions **under the effect of some hormones**

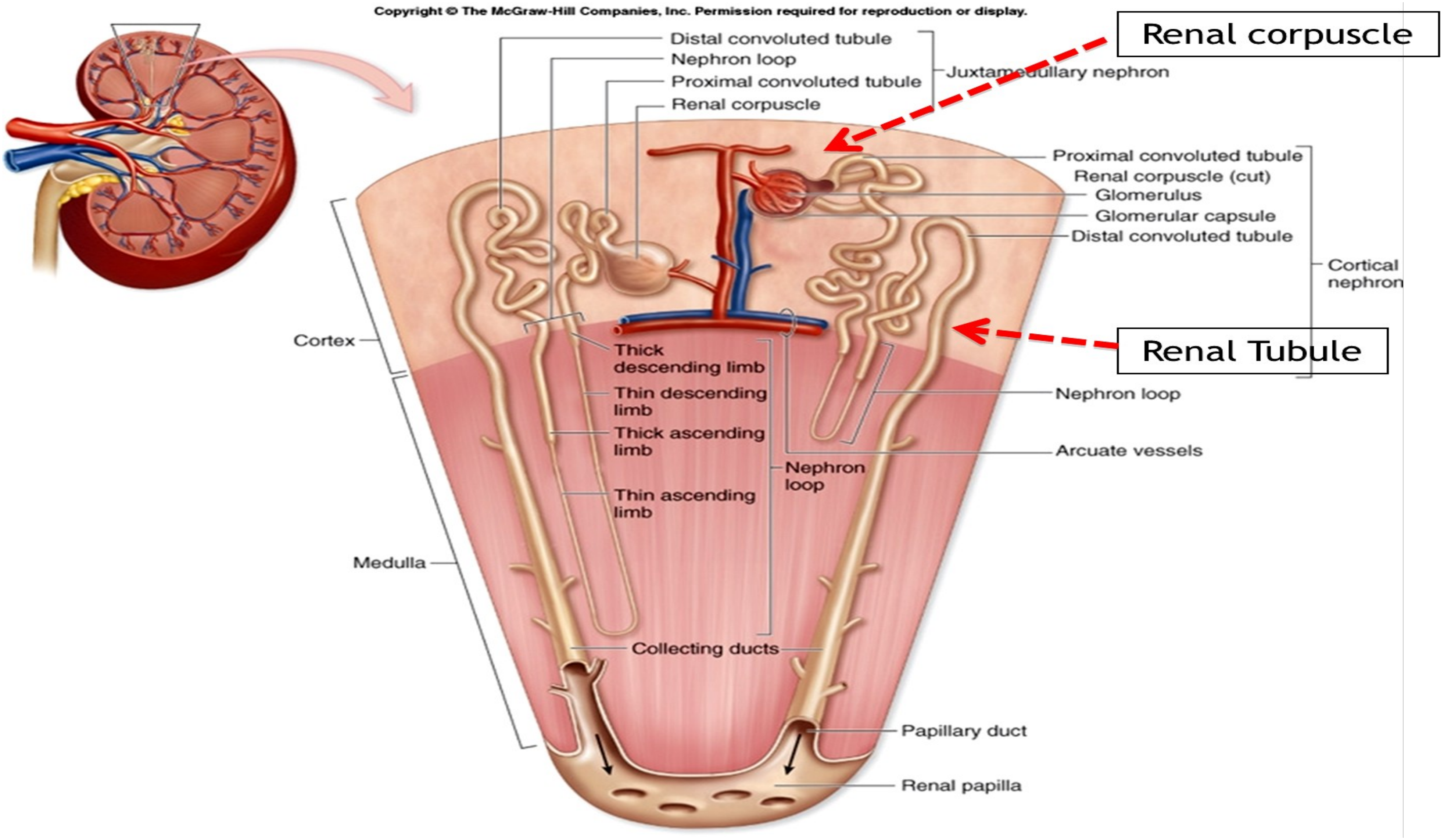
	PCT	DCT
Parts	Two parts: Convoluted Straight	Three parts: Straight Convoluted Macula densa
Length	Longest part of the nephron	Shorter
Lumen	Narrow	Wide
Lining epithelium	Large cubical cells with indistinct cell boundary	Small cubical cells with distinct cell boundary
Number of cells	3-5	5-8
Cytoplasm	Acidophilic	Lightly acidophilic
Apical pinocytotic vesicles	Present	Absent
Brush border	Present	Absent
Basal striation	Present	More apparent
Microvilli	Numerous microvilli	No microvilli
Basal infoldings	Present	Highly developed
Lateral interdigitation	Extensive	Less extensive

Collecting Tubule

It is **not part** of the nephron.

Three regions are recognized:

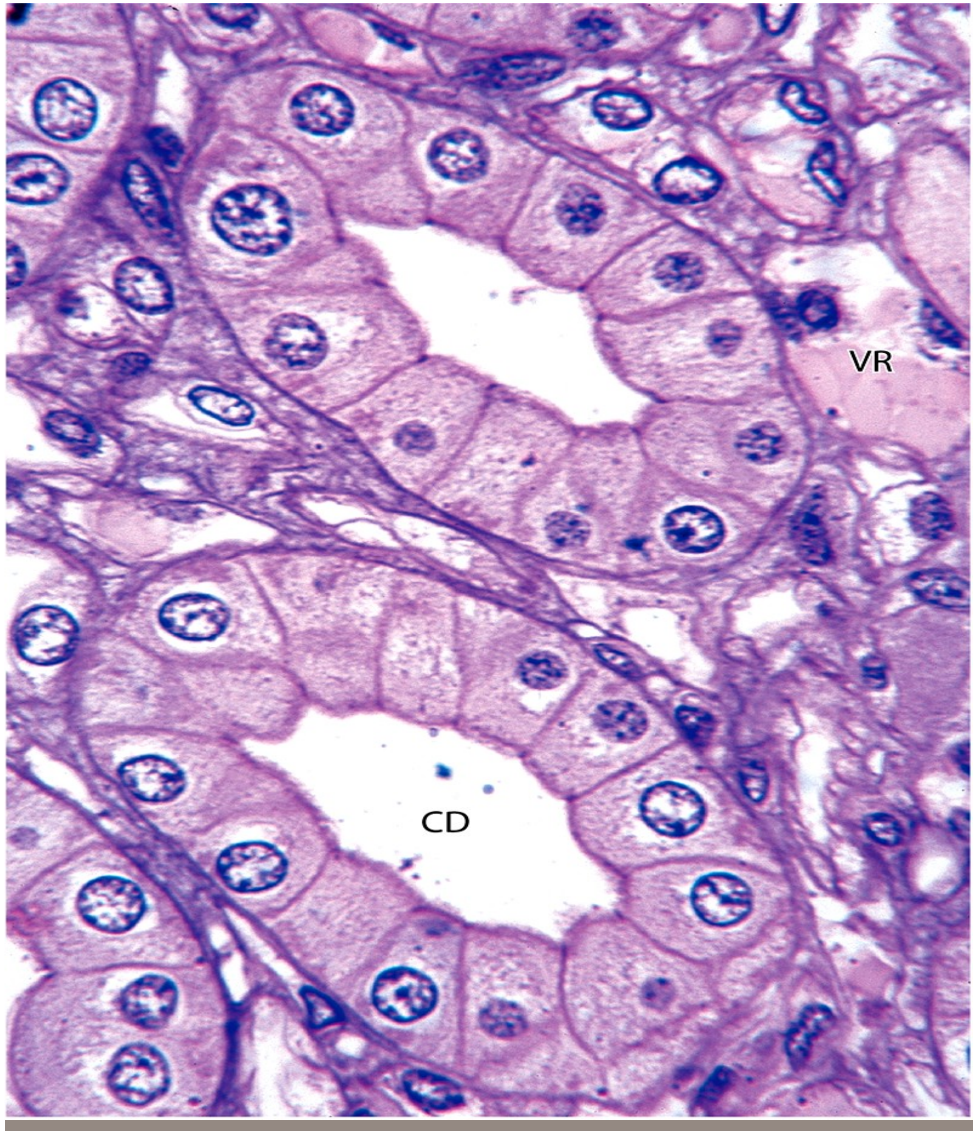
1. Cortical "in the cortex in the medullary ray"
2. Medullary "in the medulla"
3. Papillary “duct of Bellini, open at the renal papilla”



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- Lining is generally cubical to columnar epithelium in larger ducts.
- **It is lined by two types cells:**

1. **Principal cells** “more”
2. **Intercalated cells** “less”



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Principal cells:

- Numerous.
- Pale staining.
- Few organelles.
- Ion transporting with basal membrane infoldings.
- Rich in transmembrane protein aquaporin “ water channel”.

Intercalated cells:

- Fewer cells with abundant mitochondria.
- Darker cytoplasm.
- Maintain acid base balance by secreting H^+ or $HCO3^-$
- Reabsorb K ions under the effect of aldosterone.

Function of collecting tubules:

- Collection of urine
- Concentration of urine
- Regulated secretion of K^+ “principal cells”
- Reabsorption of K^+ “intercalated cells”
- Maintaining acid base balance “intercalated cells”

Summary

- Mesangial cells, two types, their role in renewal of the glomerular basement membrane.
- Structure and functions of the proximal convoluted tubules (PCT).
- Structure of the loops of Henle. It is formed of four segments.
- Structure of the distal convoluted tubules (DCT).
- Comparison between the proximal convoluted tubules and the distal convoluted tubules.
- The structure of the collecting tubules, parts, site, the lining epithelium.

Lecture Quiz

1. **The basal lamina of the glomerular filtration is cleared of occasional build up of cellular debris by the phagocytic activity of which of the following cells:**

A. Endothelial cell
B. Juxtaglomerular cell
C. Intraglomerular mesangial cell
D. Podocyte
E. Lacis cell

2. **Cells of the proximal convoluted tubules characterized by:**

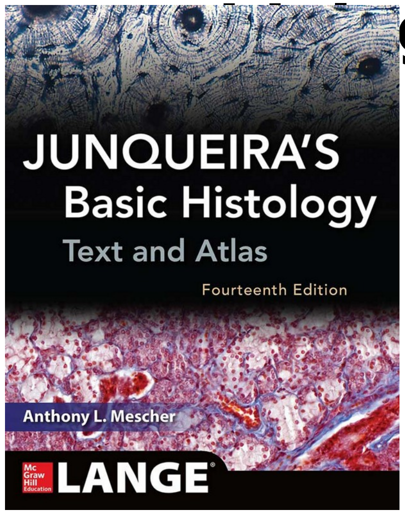
A. Have a prominent brush border
B. Exhibit extensive infoldings of the basal plasma membrane
C. Have indistinct lateral intercellular borders via light microscopy
D. All of the above

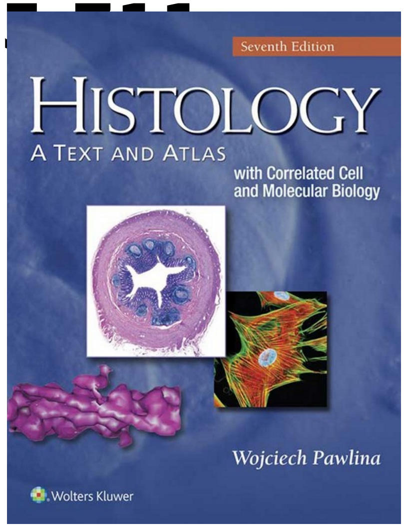
SUGGESTED TEXTBOOKS

1. **Junqueira's Basic Histology: Text and Atlas, Fourteenth Edition by Anthony Mescher (2016) p. 400-404**

2. **Histology a text and atlas with correlated cell and molecular**

gy by W. Pawlina (2016) p. 70





THANK YOU

